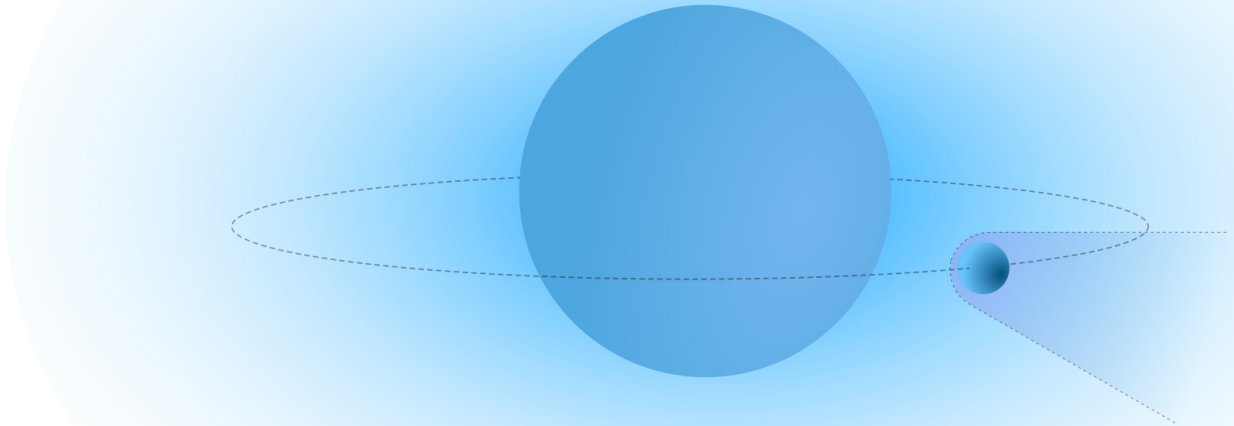
Optical and Infrared Study of the Obscured B[e] Supergiant High-mass X-Ray Binary IGR J16318-4848

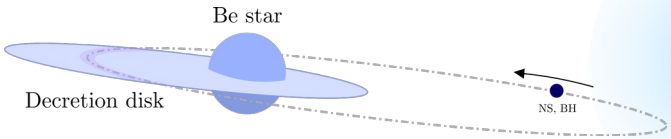


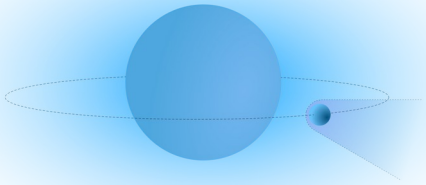
F. Fortin, S. Chaty & A. Sander, ApJ 2020

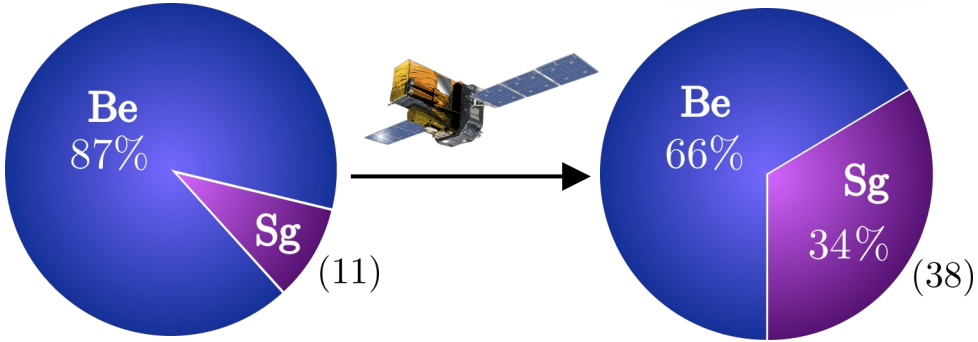
sgHMXBs revealed by INTEGRAL

BeHMXB

sgHMXB



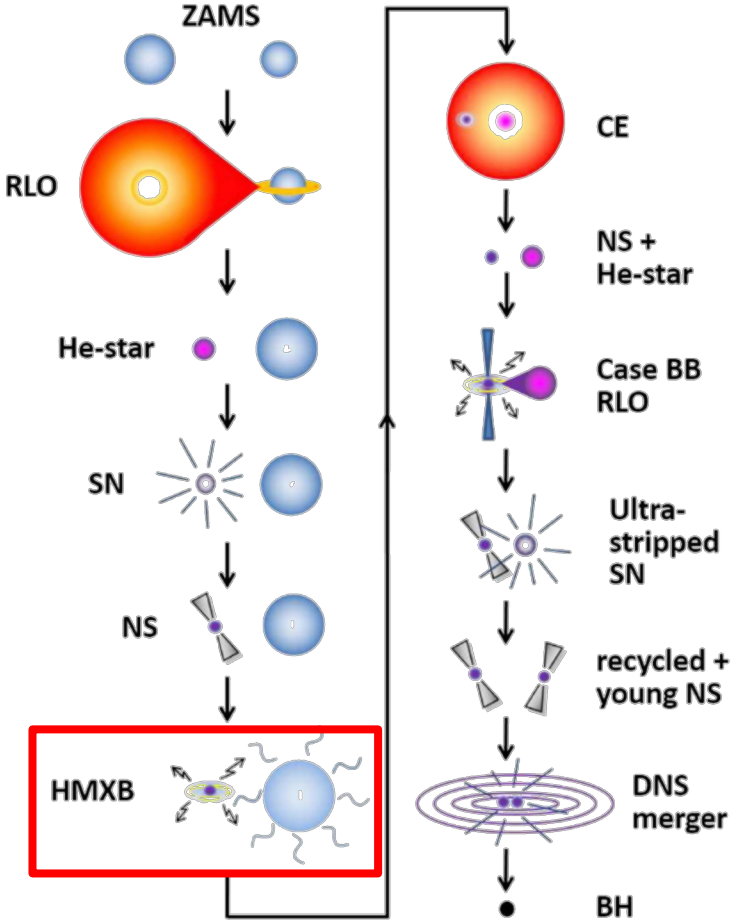




Before

After

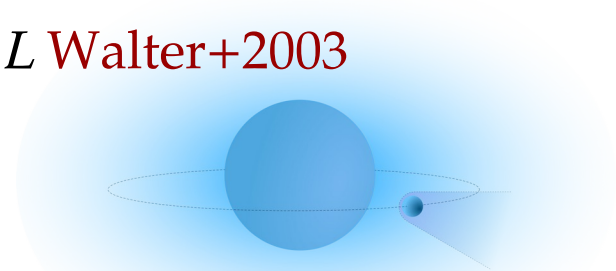
Liu+2006



Tauris+2017

Most Obscured System Since 2002™

IGR J16318-4848: the first source detected by *INTEGRAL* Walter+2003



X-rays: $N_H = 0.9 - 2 \times 10^{24}$ cm^{-2}

(*ASCA*, 2-10 keV, Revnivtsev+2003, *XMM-Newton*, 0.3 – 13 keV, Matt & Guainazzi 2003, *INTEGRAL*, 5-13 keV, Walter+2003)

Optical / IR: $A_V = 18.3$ +/- 0.4 mag

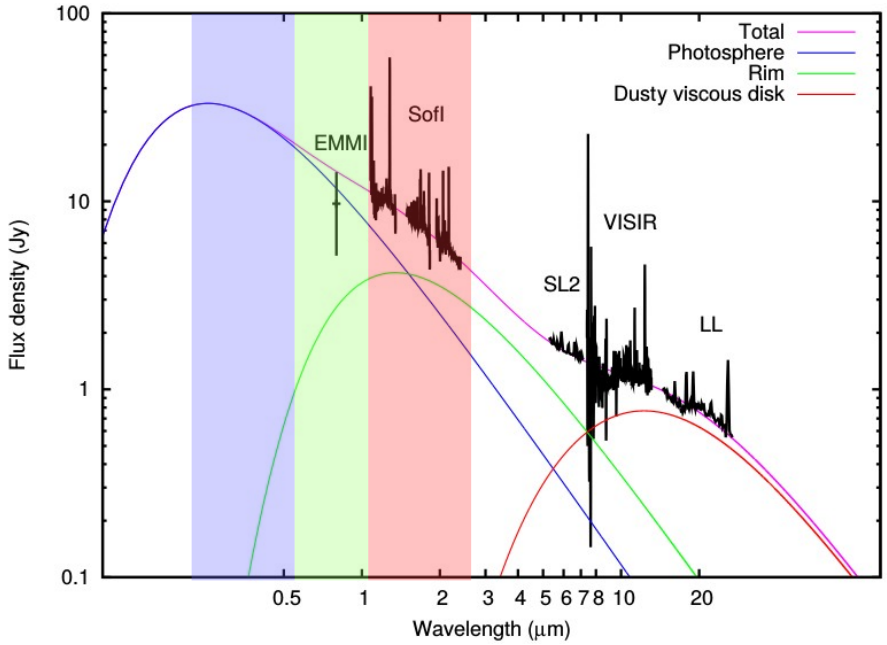
(VISIR, Spitzer & SofI, Chaty & Rahoui 2012)

X-ray absorption = 100x optical → opaque material near accretor ?

A complex environment

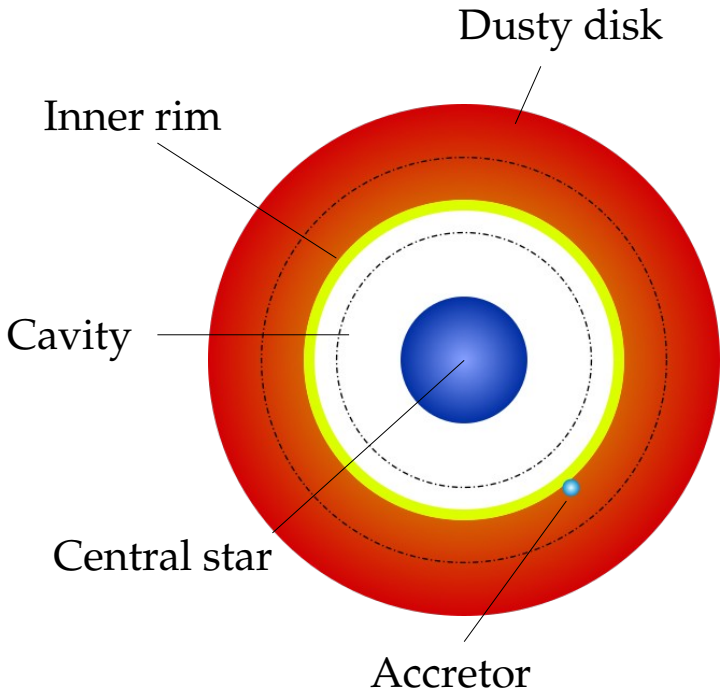
IGR J16318-4848

Broadband spectrum

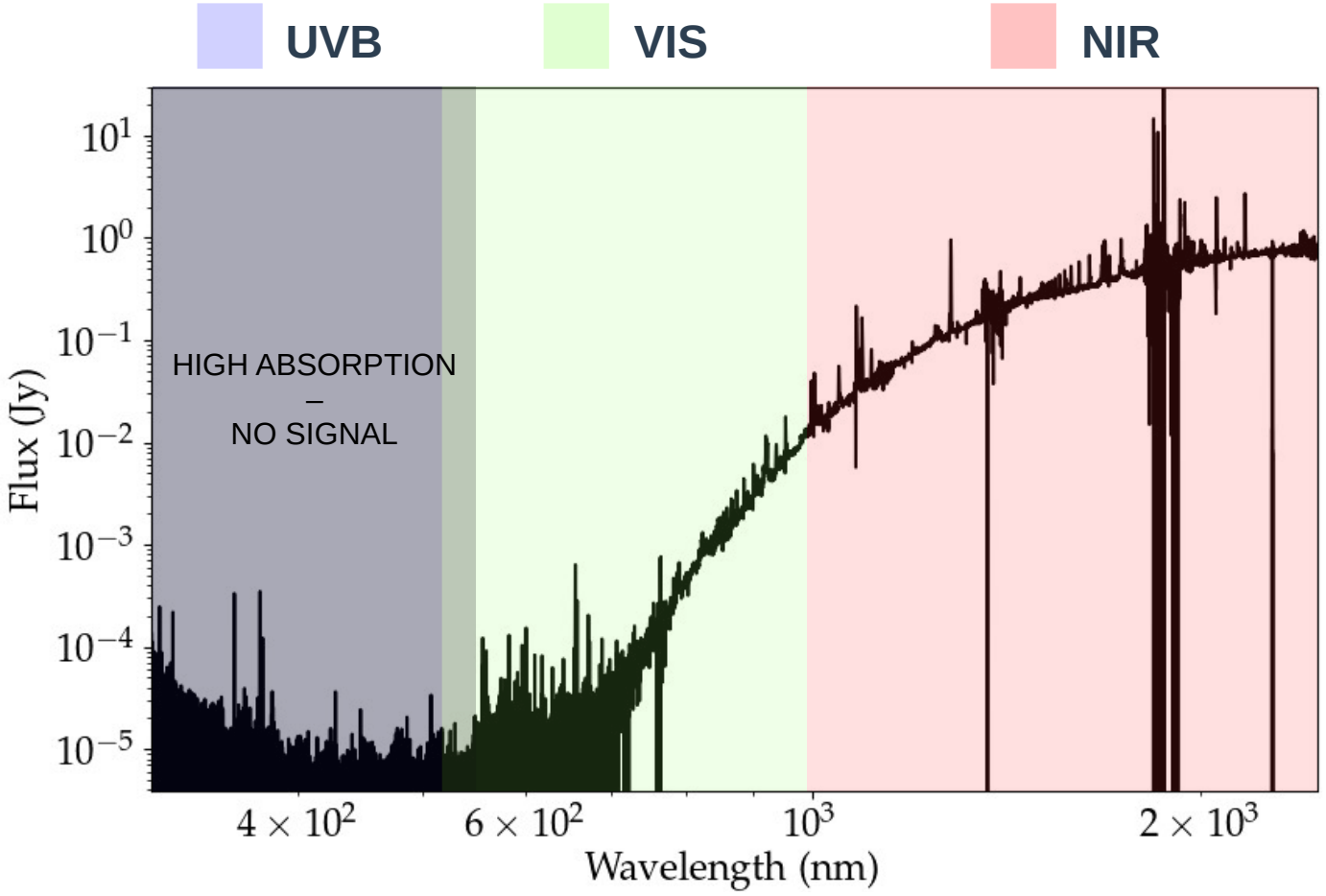


Chaty & Rahoui 2012

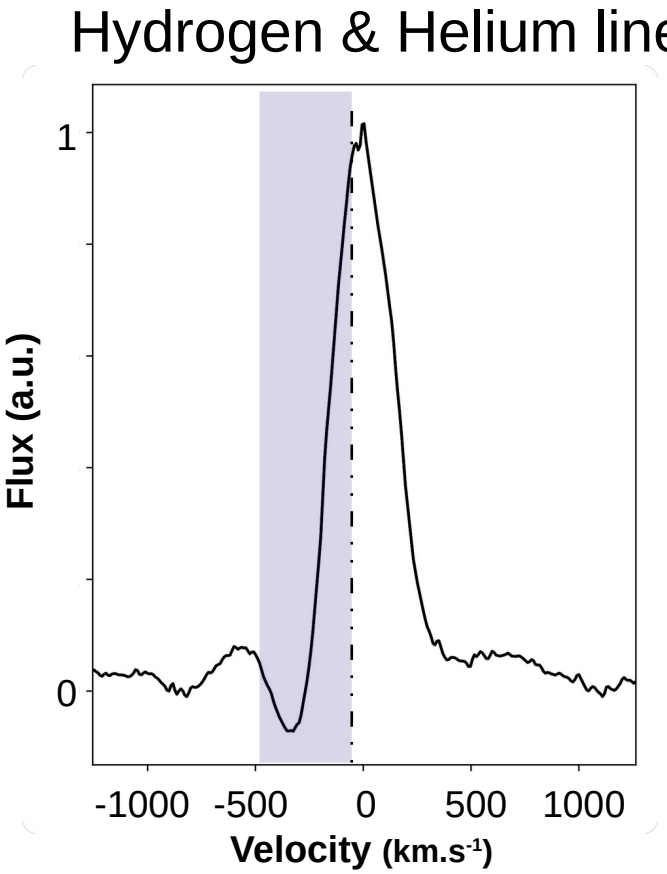
Pole-on view

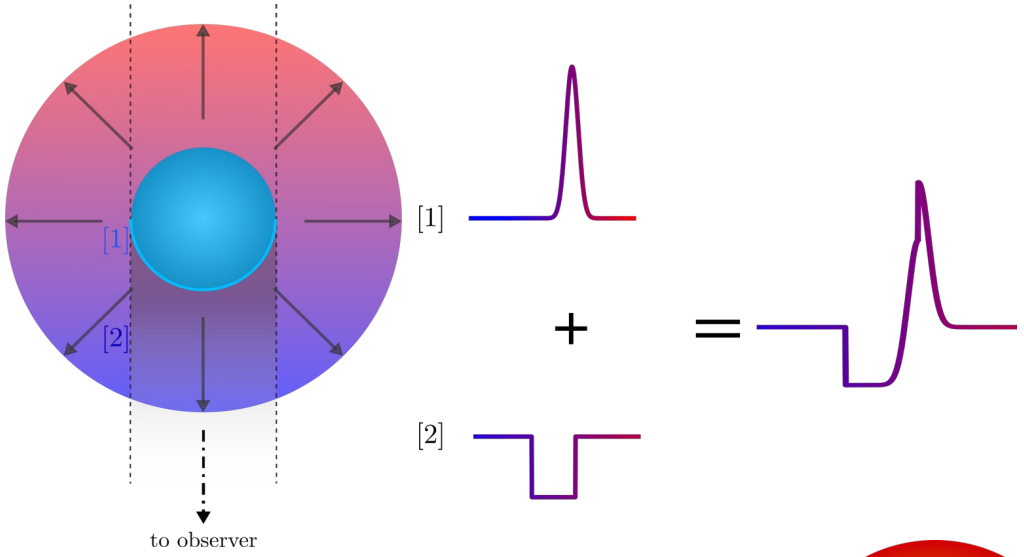


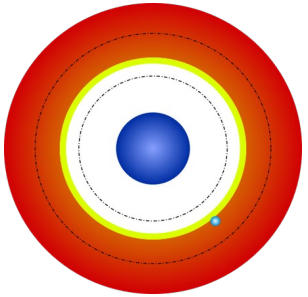
VLT/X-Shooter capabilities



Diversity of lines: illuminated stellar wind





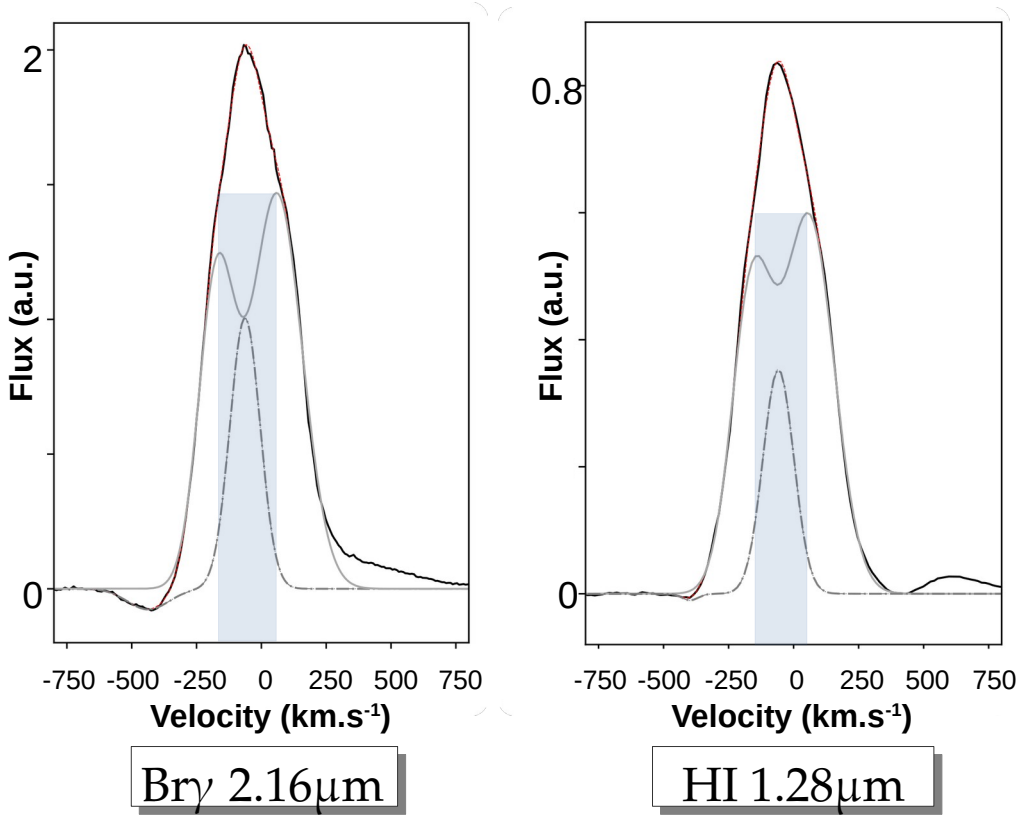


→ Equatorial wind

V_{inf} = 340 – 370 km.s^{-1}

Diversity of lines: evidence of inner rim

The strongest (and cleanest) HI lines

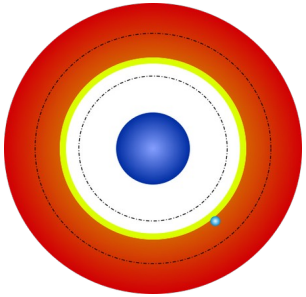


Brγ 2.16μm

HI 1.28μm

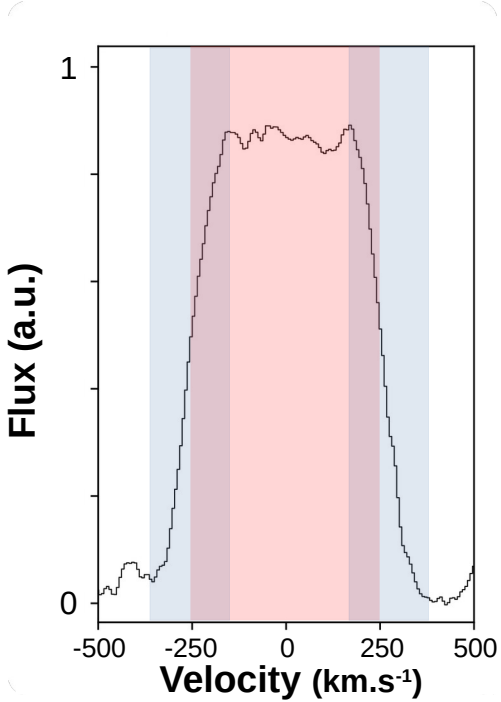
→ Associated to orbital motion of the inner rim :

V sin(i) = 113 +/- 4 km.s^{-1}

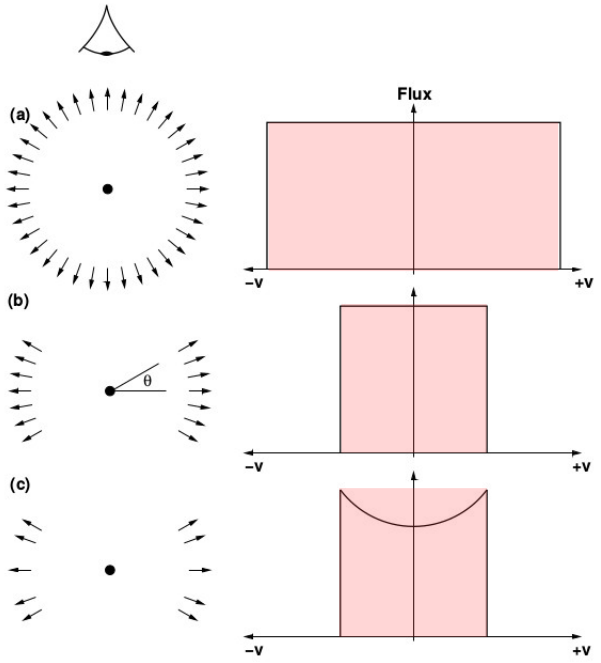


Diversity of lines: peculiar disk wind

FeII & [FeII] : Flat-topped profiles



FeII in IGR J16318-4848



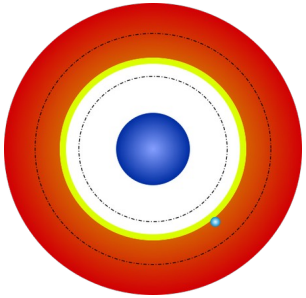
Bertout & Magnan 1987, Hynes+2002

Spherical expansion

$V_{inf} = 250 \pm 20$ km.s^{-1}

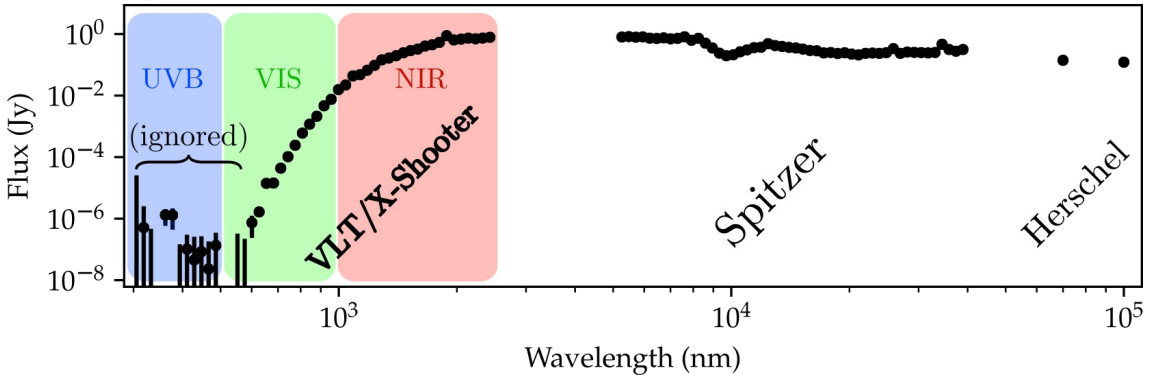
Orbital motion ?

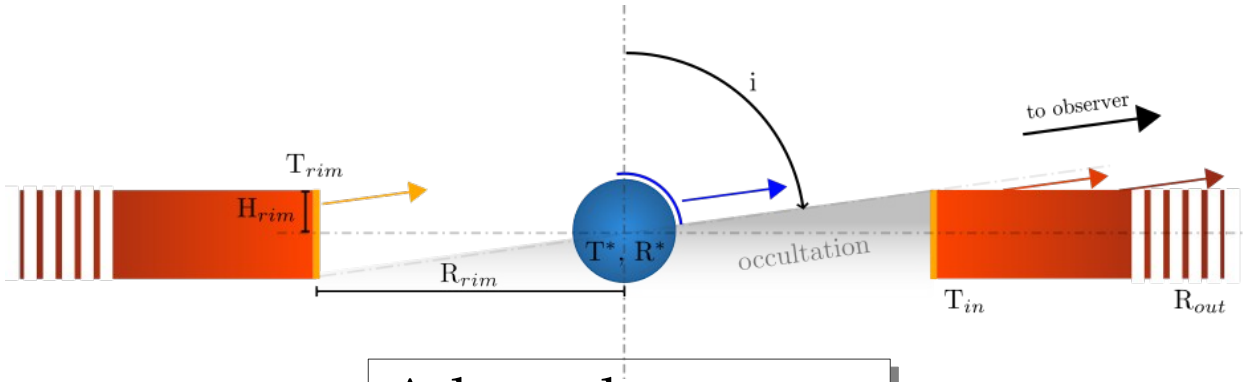
$V_{orb} = 80 \pm 20$ km.s^{-1}



Broadband spectral energy distribution

X-Shooter + Spitzer + Herschel





Adopted geometry

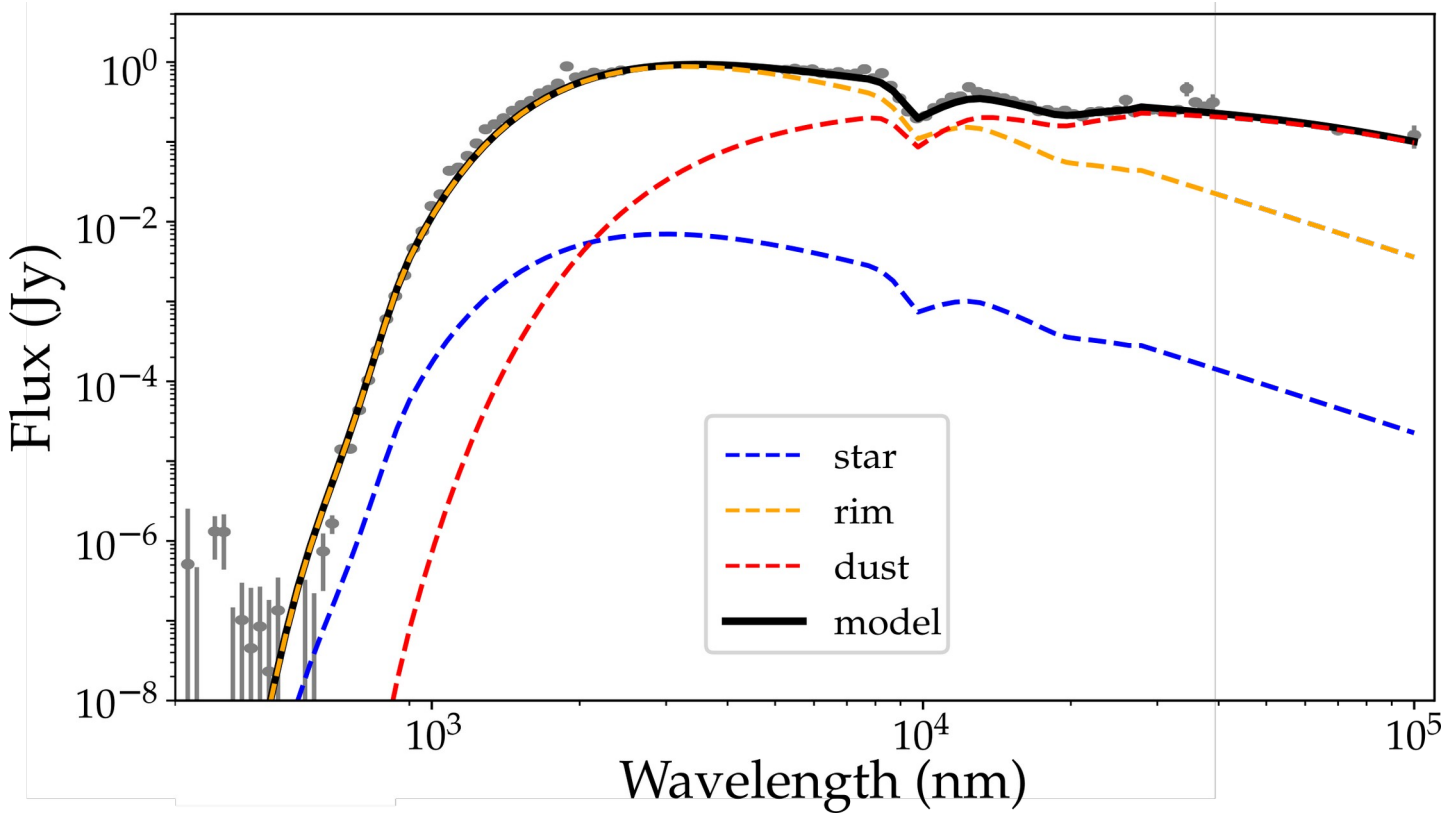
Star, Rim : blackbodies

Disk : multi-T blackbody

$$T_{disk}(r) = T_{in}\left(\frac{r}{R_{in}}\right)^{-q}$$

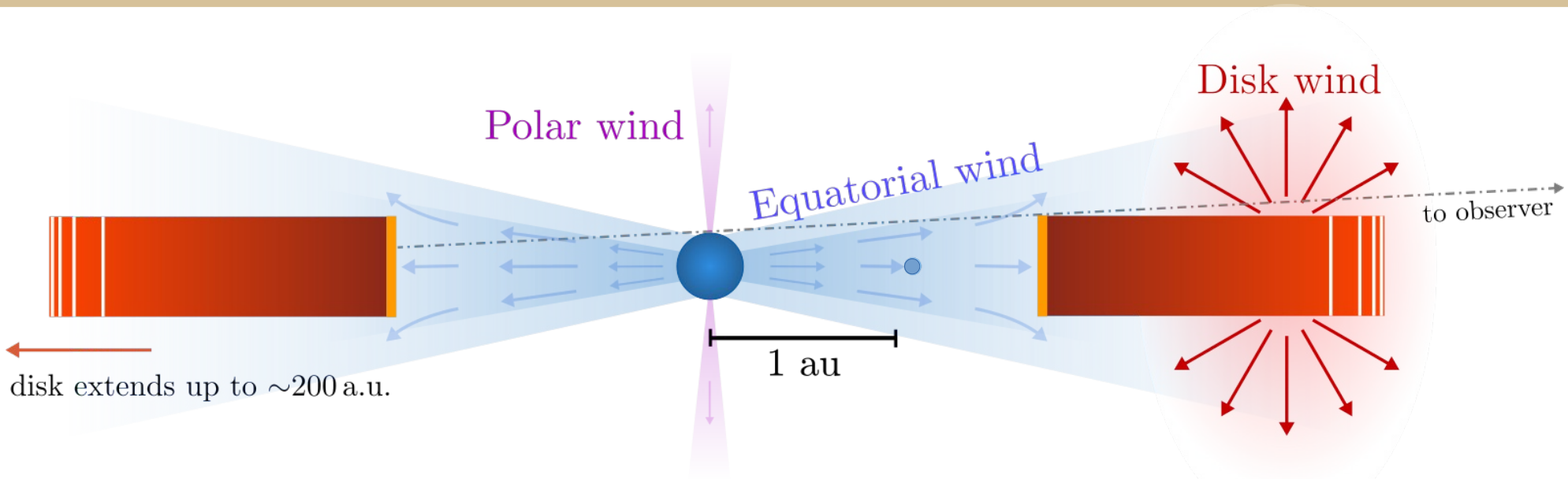
Lachaume+2007

Broadband spectral energy distribution



↘ **The central star contributes to (at most) 10 % of the visible flux**

The final picture: IGR J16318's environment



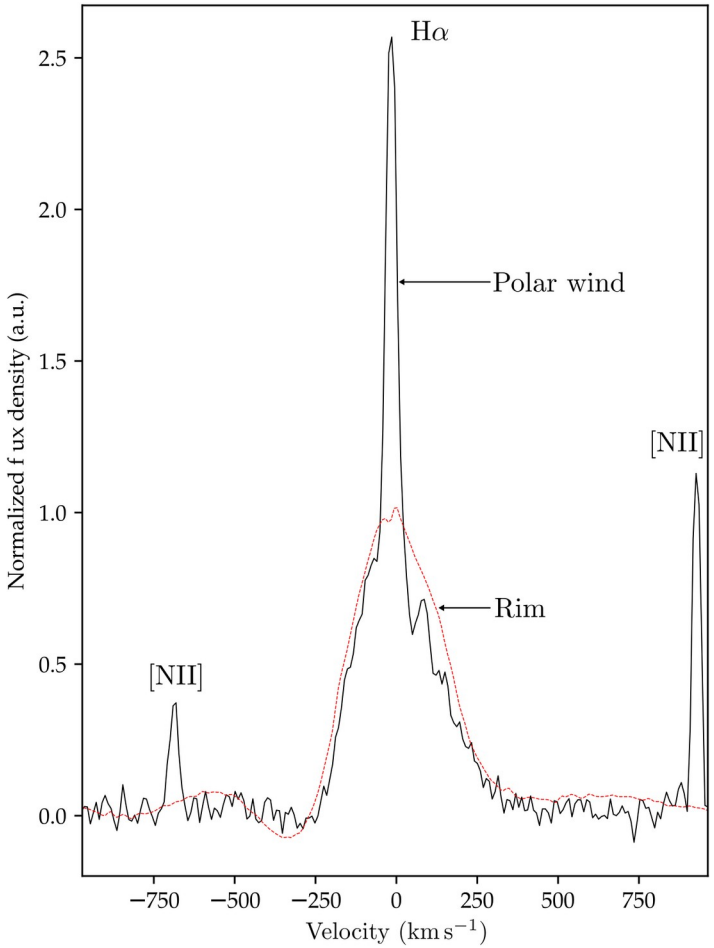
→ confirmed by stellar atmosphere & wind modeling (PoWR) !

- wind velocity
- inclination
- distance
- general geometry
- inner & outer disk
- accretor's orbit

- circumbinary material: where does it come from ?
- polar wind ?
- accretor: NS ? BH ?

Thank you for your attention !

Extra: fast polar wind ?



- depolarization across Halpha line in sgB[e] rms 82 (Seriacopi+2017)

→ produced in a large volume around the star

- no sign of narrow features in other HI (disk rim)

- if polar wind, assume v ~ 1000 km.s-1

→ inclination angle is ~88°, otherwise we should see double-peaked line

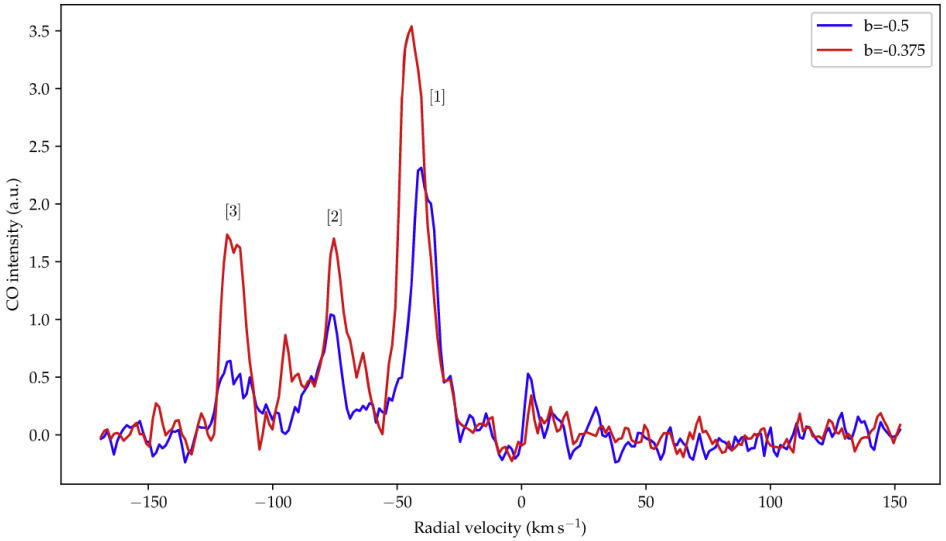
Extra: distance to the binary

- Very absorbed → Gaia parallax poorly constrained (in all data releases)
- Bayesian inference to invert parallax from Bailer-Jones+2020: 5 +/- 3 kpc
- Two star forming regions nearby at 2.4 and 4.9 kpc (Russeil 2003)
- Recovered their position in Galactic spiral arms from Dame+2001 by matching radial velocities

→ radial velocity of IGR J16318 is compatible with the SFR at 4.9 kpc.

→ incorporate this in Bayesian scheme & Gaia data:

D = 4.9 (+1.9 -1.5) kpc.



Extra: stellar atmosphere & wind modeling

- HI lines barely reproduced
- good agreement with HeI lines
- same wind velocity (~400 km.s^{-1})

→ confirms HI mainly comes from rim

→ highly He-enhanced star ?

PoWR code output compared to observed spectrum: